

# North Windham Quadrangle, Maine

Bedrock geologic mapping by

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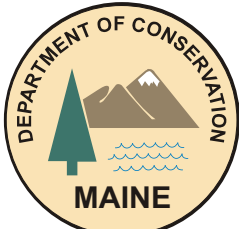
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## Maine Geological Survey

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For additional information,  
see Open-File Report 96-16.

### THE BEDROCK MAP

The geologic map at left shows features of the bedrock, the solid rock that makes up the earth's crust. The overlying sediment, which is shown on surficial geologic maps, is disregarded here. Symbols on the map show locations where bedrock is exposed at the land surface. Closely related or distinctive rock types are grouped together into formations and other rock units (see Explanation). Boundaries between these units are shown as either solid, dashed, or dotted lines on the map to indicate how well their locations are known. The cross section illustrates the inferred relationships among rock units that would be seen along a vertical slice through the earth.

### STRATIFIED ROCKS

The stratified, or layered, rocks of the North Windham quadrangle are metamorphic rocks, primarily schist and gneiss. Schist is a rock composed of small, flat minerals such as mica that are aligned to give the rock a sheet-like structure so that it splits easily. Gneiss is a more uniform rock made up of equant minerals, such as quartz and feldspar, which are not elongated in any particular direction so that the rock breaks into chunks. A schist or gneiss may have a variety of distinguishing characteristics, such as different mineral contents or different grain sizes. For example, calc-silicate gneiss is a gneiss that contains minerals with calcium and silica such as diopside and plagioclase.

The stratified rocks were originally sediments that accumulated in an ocean basin during the late Ordovician to Silurian Periods (see Geologic Time Scale below). Geologic processes gradually turned these sediments into rock so that sedimentary characteristics such as layering are preserved, but in a modified form. Beds of sand, silt, and mud became layers of gneiss and schist of the Rindgemere Formation (**Photo 1**). Limestone and limy sand became marble and calc-silicate gneiss in parts of the Windham Formation (**Photo 2**). Beds of muddy silt or limy silt became biotite-bearing or calc-silicate gneiss layers, respectively, of the Hutchins Corner Formation (**Photo 3**). The map distribution of these rocks as thin, parallel units also suggests that they form regionally continuous layers.



**Photo 2.** Brown-weathered calcite marble weathers more deeply than the light green calc-silicate rock, accentuating the layering. The calc-silicate rock contains green diopside, white plagioclase, and quartz. Metalimestone member, Windham Formation; Dundee Falls, Presumpscot River.



**Photo 1.** Beds 1/2 to 3 inches thick of feldspar-rich gneiss (g) and schist (s) indicate a sedimentary origin for this rock. Rindgemere Formation; southeast side of Rt 35, 1.4 miles south of Eel Wier Canal.



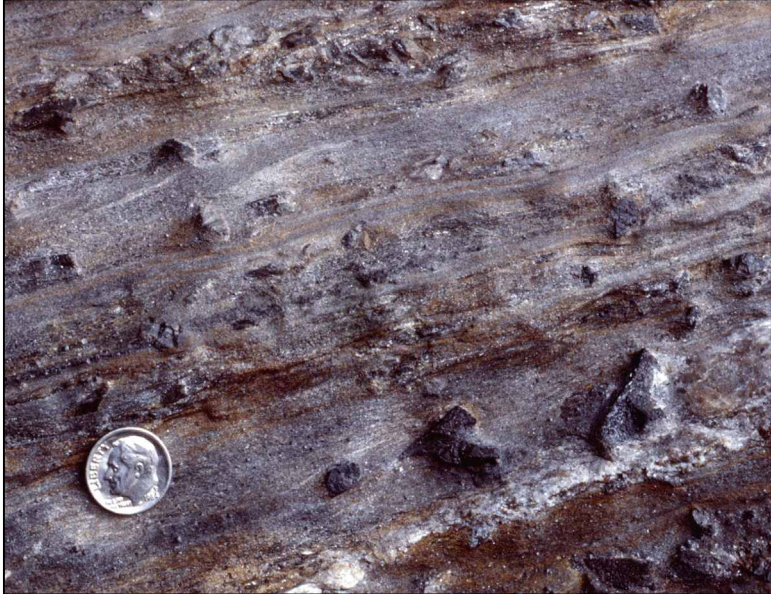
**Photo 3.** Layered gneiss of the Hutchins Corner Formation. Medium-grained biotite-quartz-feldspar gneiss weathers to a brown, slightly crumbly surface. Light gray layers are calc-silicate gneiss with much less biotite. Small, white granite veins cut across layers. Layers are tilted down to the right (southeast). Northeast side of Pope Rd., 0.1 mile west of Colley Wright Brook.

### METAMORPHIC AND STRUCTURAL FEATURES

In the Devonian Period and again in the Carboniferous, central New England was geologically active. Rocks now at the earth's surface in southern Maine were then at depth, subjected to heat and pressure in the earth. These factors caused metamorphism (literally, a change in form) of the rocks. For example, the muddy sediments were recrystallized into mica schist (**Photo 4**), typical of the Windham Formation. In rocks with the necessary chemical constituents, new minerals such as garnet, staurolite (**Photo 5**), kyanite (**Photo 6**), and sillimanite grew. The rock mass was deformed by folding and faulting in response to the pressure. Layers were distorted into folded shapes (**Photo 7**), or tilted away from horizontal (**Photo 3**). This deformation occurred on a regional scale, as indicated by the inclined bedding throughout the map area and by the structure shown on the interpretive cross section.



**Photo 4.** Schist that has split parallel to the foliation plane. The shiny, reflective surface is due to mica that grew during metamorphism. The schist has been crinkled, producing delicate lineations (parallel to arrows) on this surface. Field of view about 6". West side of Rt. 202, 0.2 miles north of Pleasant River.



**Photo 5.** Bedded staurolite schist of the Windham Formation. The "twinning" shape near the right edge is characteristic of the metamorphic mineral staurolite. Layers of thin, light gray quartzite and darker schist were sand and mud, respectively, in the original sediment prior to metamorphism. Dundee Falls, Presumpscot River.



**Photo 6.** Unusually large crystals of the pale blue, bladed mineral kyanite in a quartz pod from the Windham Formation. Kyanite occurs commonly as small grains in schist in the Windham Formation. Metamorphic conditions were not appropriate for kyanite to form in most of southern Maine. Field of view is 6 inches.



**Photo 7.** Folded layers of quartzite and calc-silicate rock are cross-cut by a granite dike. Rocks can only be deformed this way at high temperatures. This particular granite intruded after the folds had already formed, since the dike is not folded. Metalimestone member, Windham Formation; 0.1 mile north of Fosters Corner.

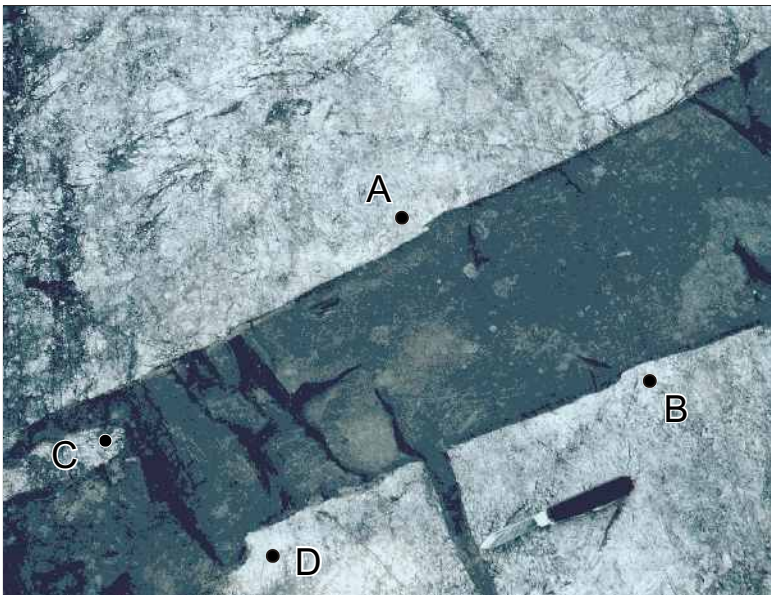
### INTRUSIVE ROCKS

During and after the metamorphism and deformation, melting occurred in parts of the crust to produce magma (molten rock). The magma forced its way into rocks of the region, cutting across the pre-existing layers. It cooled slowly underground to produce coarse-grained igneous rocks such as granite (**lower part of Photo 7**) and pegmatite. The northern part of the quadrangle is underlain by granite of the Sebago batholith, Maine's largest granite body, extending north to Norway and westward past Fryeburg. The Sebago granite (**Photo 8**) is of Carboniferous age, but the ages of the other small granite bodies in the quadrangle are not known.

The youngest rocks are thin dikes of black, fine-grained igneous rock (**Photo 9**). They formed when magma intruded into relatively cool, solid rock along straight fractures. These northeast-trending dikes formed during the Mesozoic Era, at the time when Europe and Africa were rifting away from North America to begin forming the modern Atlantic Ocean.



**Photo 8.** Granite of the Sebago batholith. Medium-sized grains are distributed randomly through the rock. The main minerals are feldspar (white) and quartz (light gray), with scattered flecks of the two micas biotite (black) and muscovite (pale yellow). From outcrop 0.5 miles northwest of Pettengill Pond.



**Photo 9.** Dike of dark igneous rock cutting through granite. Black rim at edge of dike formed when hot magma was rapidly frozen against cold granite. Small grains are difficult to see without magnification. Before the granite split apart, point A was next to point B, and C was next to D. Magma also flowed into small crack by knife blade. In small granite body, 0.1 mile north of Fosters Corner.

### GEOLOGIC TIME SCALE (in millions of years before present)

Geologic Age	Absolute Age*
Cenozoic Era	0-66
Mesozoic Era	66-245
Cretaceous Period	66-144
Jurassic Period	144-208
Triassic Period	208-245
Paleozoic Era	245-545
Permian Period	245-286
Carboniferous Period	286-360
Devonian Period	360-415
Silurian Period	415-443
Ordovician Period	443-495
Cambrian Period	495-545
Precambrian time	Older than 545

\*From Palmer (1983) and Tucker and McKerrow (1995).